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AUTHOR Maeda, Jiro
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ABSTRACT

The development and use of broadcasting satellites in Japan are discussed in this paper. The paper describes the medium-scale experimental broadcasting satellite, YURI, launched by NASA in 1978, and reports that experiments with YURI in the areas of basic technologies in the broadcasting satellite system, experiments on satellite control technologies and operational control techniques for the satellite broadcasting system, and experiments of reception of radio waves from a broadcasting satellite have shown favorable results and that practical application of broadcasting satellites are technically feasible within the foreseeable future. It recommends to the Space Activities Commission of Japan that an operational broadcasting satellite be launched in 1983, prior to the planned launchings of space platforms in 1985 and 1990. The paper notes that space development in Japan has now reached a turning point that will lead from the initial phase of ground work consolidation to a second phase of practical application, working under the auspices of the Telecommunications Satellite Corporation of Japan, recently established by the Japanese Diet. Objections of commercial broadcasters who fear disruption of regional broadcasting by broadcasting satellites are also presented. (MKM)

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DIRECT BROADCASTING SATELLITES IN JAPAN

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Jiro Maeda

Director, International Relations

Mainichi Broadcasting System, Inc., Japan

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[1] Japan's Space Development Program

"The space program in Japan has now reached the end of an initial stage of development, the consolidation of groundwork conducted over a period of more than ten years. At this point, the space program is ready to move into a second phase of development, the promotion of various projects in the fields of both scientific research and practical application.

"However, space development requires comprehensive and advanced technology, and can only be accomplished over an extremely long period of preparation and development. It is not easy to promote such development once the situation has become acute. Moreover, since space development requires a large amount of government funds, the appropriateness of the choice of development objectives must necessarily have a large influence on national interests. Consequently, if space development is to make further progress, it must be conducted on the basis of long-range prospects and indices, and it must proceed in phases of development and consolidation allowing for accurate assessment and ongoing reevaluation at each stage."

The above statement is taken from the introduction of "An Outline of Japan's Space Development Policy" published in March, 1978, by the Space Activities Commission of Japan.

The Space Activities Commission was established in 1968 in order to bring space development being conducted severally by a number of bodies under a unified program that would ensure uniform and comprehensive development. The Space Activities Commission belongs to the Prime Minister's Office, and in 1969 it drew up Japan's first Space Development Program, and every year since that time has revised the program in line with changes in the pace of technological progress and the outlook for the future. In March, 1978, the Space Activities Commission drew up the outline of Japan's Space Development policy that sets out basic space development policy for the next fifteen years or so and this will provide policy guidelines for future promotion.

In 1969 the National Space Development Agency of Japan (NASDA) was established as a special juridical body to act as the central executive body in Japan's Space Development Program.

NASDA is engaged in the following activities:

(1) Development of satellites and rockets for satellite launching as well as development of the necessary facilities and equipment for this.

(2) Satellite launching and such tasks as setting the satellite on its geostationary orbit and testing during initial operation to ensure that it can carry out its specific functions. The satellite is to be transferred to the user once the above initial operation is successfully done.

(3) Subsequent satellite tracking and orbital correction.

"Outline of Japan's Space Development Policy" (formulated by the Space Activities Commission in 1978)

The "Outline of Japan's Space Development Policy" published in March, 1978, lays down basic policy guidelines and a framework for space development in Japan over the next fifteen years or so. The basic principles of space development policy stated therein is that "Japan's space development should be confined to peaceful purposes, and should be able to respond fully and effectively to various social needs." Further, "Japan should develop an independent technological capability, and should endeavor to take the initiative in at least the main areas of space activities systems - design technology, production technology and operations control of the major systems." Space development "should be conducted in keeping with space development activities around the world."

The next fifteen years will see the Development Series brought into operation. From around 1985 the First Generation Space platform, able to carry a large-scale antenna and high-powered transmitter, will be developed and launched via the H-1 rocket. Subsequently, it is envisaged that from around 1990 the Second Generation Space platform, able to carry even

larger-scale and more highly powered equipment, will be developed. The space platform will be equipped with a large power source, large-scale antenna and high powered transmitter so that it can function either as a broadcasting satellite, a communications satellite, or satellites for other purposes according to usage.

Broadcasting Satellites in Japan:

The development of broadcasting satellites in Japan is also conducted as part of the unified Space Development Program, as previously described, under development projects of the Communications Division.

[II] The Medium-Scale Experimental Broadcasting Satellite (BSE) "YURI"

The Japanese BSE project was initiated by the Ministry of Posts and Telecommunications (MPT) in 1972, and conceptual and preliminary designs of the satellite were worked out in cooperation with the Japan Broadcasting Corporation (NHK).

In 1973, the BSE project was incorporated as a new project in the Space Development Program by the Space Activities Commission and the preliminary design results were transferred to the National Space Development Agency of Japan (NASDA).

NASDA proceeded to develop the satellite by the establishment of a contract for manufacturing BSE with Tokyo Shibaura Electric Co., Ltd., as a maincontractor, and General Electric Co., as a subcontractor.

Ground facilities and equipment for the BSE experiments were constructed by MPT in cooperation with NHK and those for the tracking, telemetry and command were provided by NASDA.

(1) Objectives

It is expected that satellite broadcasting will become an important communication medium in the future.

The BSE project is intended to conduct various experiments for accomplishing satellite broadcasting technologies as a first step towards an operational satellite-broadcasting system so as to cope with various broadcasting demands.

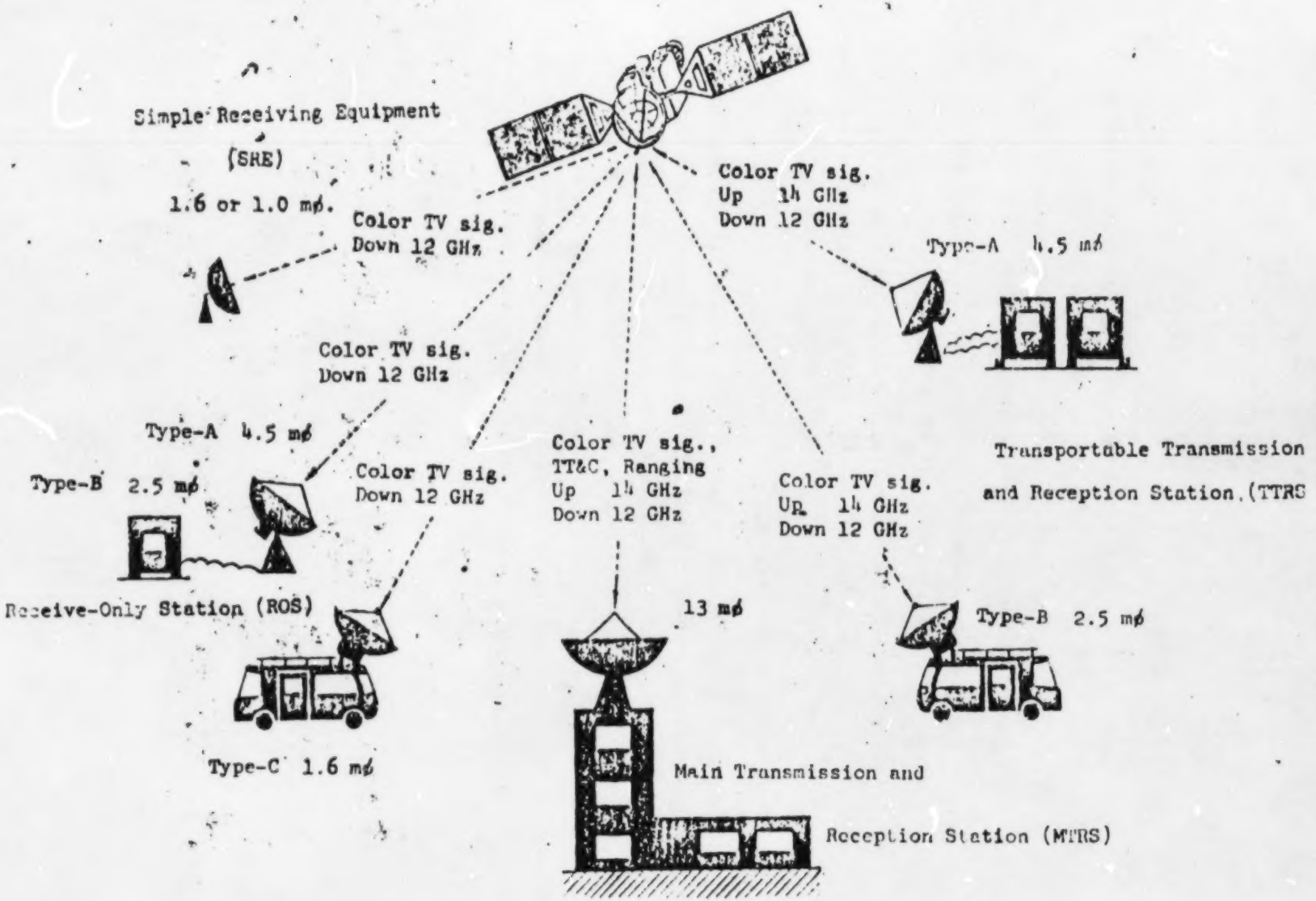
BSE is equipped with a shaped beam antenna in order to fit the radiation pattern to the shape of the Japanese territory and operates in the 12 GHz band allocated to the broadcasting-satellite service.

(2) System for BSE Experiments

The system consists of the satellite and the ground segment, i.e., a Main Transmission and Reception Station (MTRS), two kinds of Transportable Transmission and Reception Stations, three kinds of Receive-only Stations and simple Receiving Equipments as shown in the figure.

The MTRS, located at the Kashima Branch of RRL, has the central role in the project.

The above stations are linked with telephone, facsimile and data communication links so as to carry out various experiments effectively. The MTRS and the NASDA's tracking network are linked as well.


Simple Receiving Equipment
(SRE)
1.6 or 1.0 mø.
Color TV sig.
Down 12 GHz
Color TV sig.
Up 14 GHz
Down 12 GHz
Type-A 4.5 mø
Color TV sig.
Down 12 GHz
Type-A 4.5 mø
Type-B 2.5 mø
Color TV sig.
Down 12 GHz
Color TV sig.,
TT&C, Ranging
Up 14 GHz
Down 12 GHz
Color TV sig.
Up 14 GHz
Down 12 GHz
Transportable Transmission
and Reception Station (TTRS
Receive-Only Station (ROS)
13 mø
Type-B 2.5 mø
Type-C 1.6 mø
Main Transmission and
Reception Station (MTRS)

SATELLITE

(1) Launching

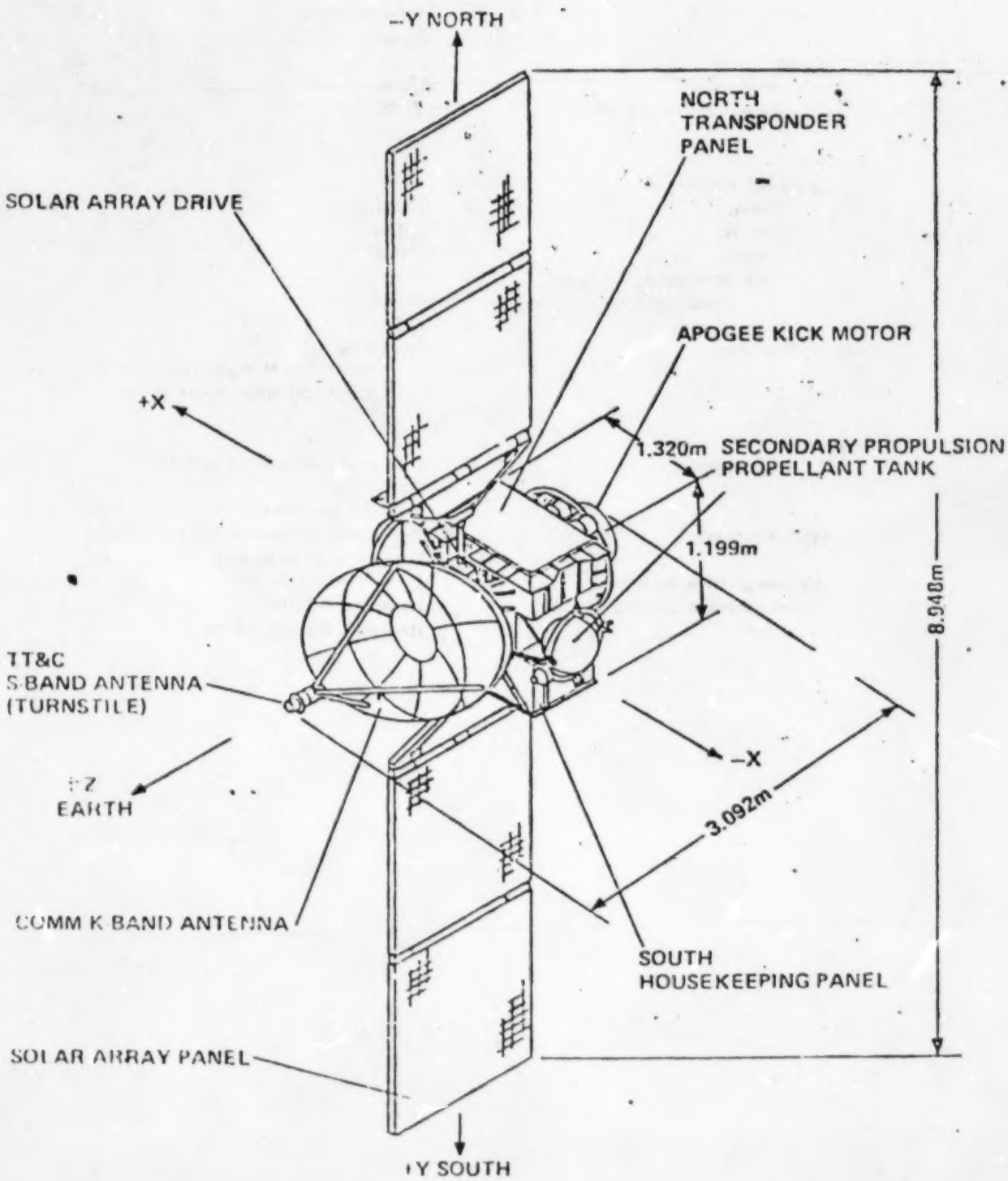
On April 8, 1978 (Japan Standard Time), BSE was launched successfully from the Eastern Test Range (ETR) at Cape Canaveral in Florida in the United States of America aboard a Delta 2914 Launch Vehicle by the U.S.A. National Aeronautics and Space Administration (NASA).

NASA injected the spacecraft into the transfer orbit and NASDA placed it on the geostationary orbit at 110°E.

NASDA is responsible for checking the initial performance of the satellite on orbit and then MPT is responsible for carrying out various experiments in cooperation with NHK and NASDA for about three years.

(2) Description of the Satellite

BSE, 3-axis stabilized geostationary satellite, is equipped with deployed solar array panels for efficient generation of high power. The satellite consists of seven subsystems, i.e., the communication subsystem, the tracking, telemetry and command subsystem, the attitude and antenna control subsystem, the electrical power subsystem, the spacecraft propulsion subsystem (reaction control equipment, apogee kick motor), the thermal control subsystem and the structure subsystem.


-Y NORTH
NORTH
TRANSPONDER
PANEL
SOLAR ARRAY DRIVE
APOGEE KICK MOTOR
+X
1.320m SECONDARY PROPULSION
PROPELLANT TANK
1.199m
8.948m
TT&C
S BAND ANTENNA
(TURNSTILE)
-X
+Z
EARTH
3.092m
COMM K BAND ANTENNA
SOUTH
HOUSEKEEPING PANEL
SOLAR ARRAY PANEL
+Y SOUTH

SPACECRAFT CHARACTERISTICS

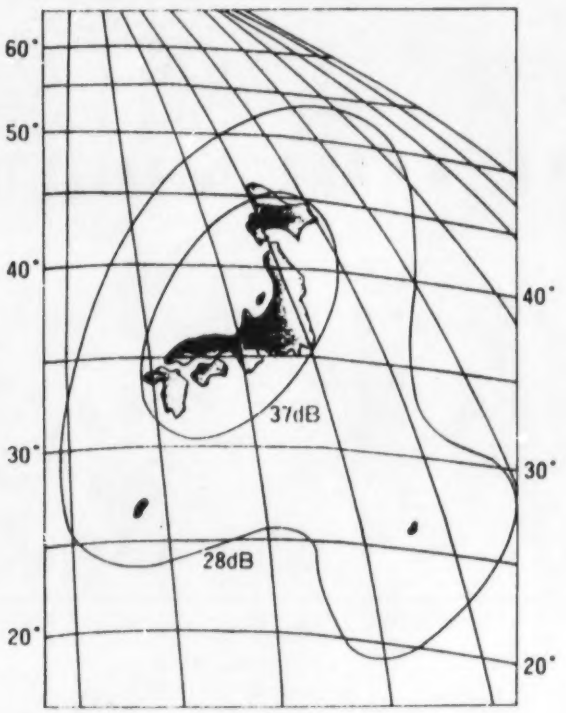
General	
Launch vehicle	Delta 2914
Orbit:	Geosynchronous 110° E
Life	3 years
Weight	
At launch:	675kg
On geosynchronous orbit:	355kg
Structure	
Spacecraft dimensions	
Width:	132cm
Length:	120cm
Height:	309cm
Solar array panel (Deployed)	
Total length:	895cm
Width:	148cm
Electric power sources	Solar array
	1000 Watts at beginning of life
	About 780 Watts at end of life
Control:	
TT & C subsystem	S band omni-directional antenna
	S band (USB)
	K band/S band converter
Attitude control:	Zero-momentum wheels and hydrazine thrusters in all three axes
Antenna pointing accuracy:	Better than 0.2 degrees
Station keeping orbit control:	Hydrazine thrusters
Thermal control:	Heat pipe, thermal coating

(3) Transponder and Antenna Pattern

The communication subsystem consists of transponders and an antenna, and has a capacity of two color TV channels.

The antenna beam is shaped in order to radiate TV signals efficiently over Japanese territory. This beam pattern, as shown in the figure, provides for a rapid falloff westward of Japan and a wider beam to the eastward. The transmission antenna gain is above 37 dB within the Japanese Mainland, and above 28 dB at Okinawa and Ogasawara islands. This shaped beam pattern is accomplished by means of an elliptical reflector using a power splitting three horn feed.

High quality color TV signals can be received by the Simple Receiving Equipment with a 1.6 mø antenna within the 37 dB contour and by the Receiving-only Stations with a 4.5 mø antenna within the 28 dB contour.

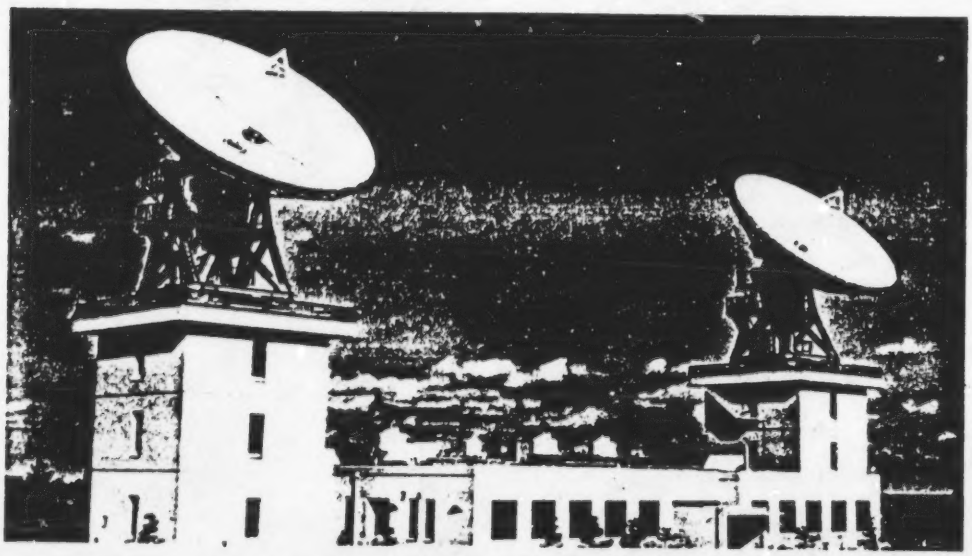


Coverage contours of the BSE

GROUND FACILITIES

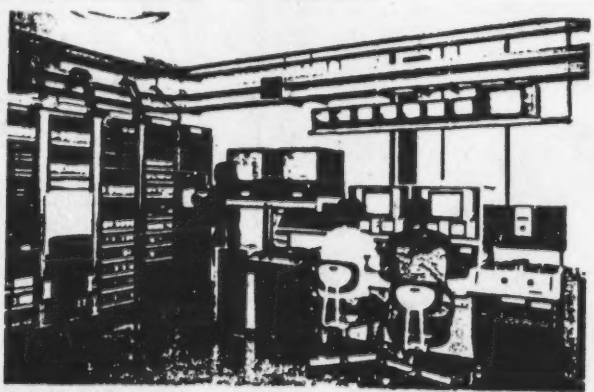
(1) Main Transmission and Reception Station (MTRS)

The MTRS, located at the Kashima Branch of RRL about 100 km north-east from Tokyo, has a 13 mø antenna. This station is used for transmitting and receiving experiments of color TV signals, and also functions as a satellite operational control station.



Antenna for the BS experiments (left)

運用管制用制御卓 Satellite control consoles



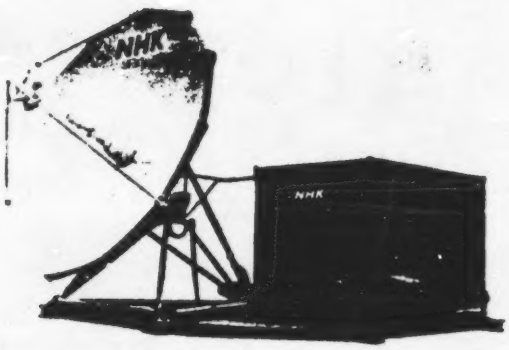
各種実験端局装置
Terminal equipment for experiment

(2) Transportable Transmission and Reception Station (TTRS)

There are two types of TTRS as shown below:

(i) Type-A

The station equipped with a 4.5 mø antenna for transmission of 1 color TV signal and reception of 2 color TV signals.



Transportable Transmission and Reception Station (Type A)

(ii) Type-B (Vehicle-mounted-type)

The station equipped with a 2.5 mø antenna for transmission of 1 color TV signal and reception of 2 color TV signals.

Transportable Transmission and Reception Station (Type B) (vehicle-mounted type)

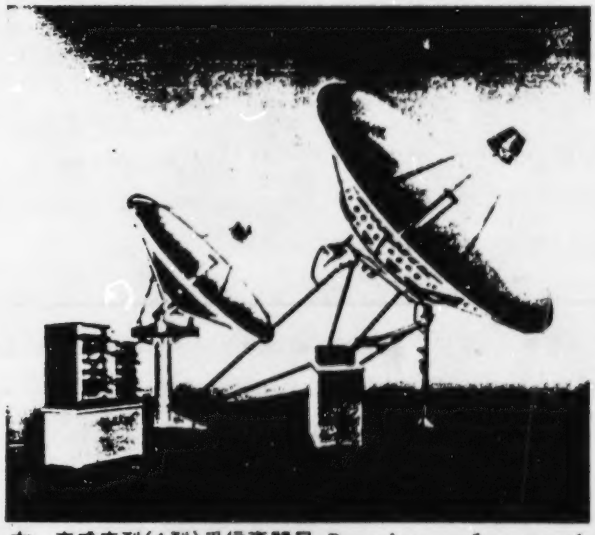
(3) Receive-Only Station (ROS)

There are three types of ROSs as shown below. They are capable of receiving 2 color TV signals simultaneously.

(i) Type-A (high sensitivity type)
The station is equipped with a 4.5 mø antenna, located at Okinawa and Ogasawara islands.

(ii) Type-B (medium sensitivity type)
The station is equipped with a 2.5 mø antenna, located on the Japanese Mainland.

(iii) The station is equipped with a 1.6 mø antenna, located at various points in Japan.



右 高感度型(A型)受信専門局 Receive-only station
左 中感度型(B型)受信専門局 R: Type A
L: Type B

(4) Simple Receiving Equipment (SRE)

SREs are used for evaluating the quality of color TV signals radiated from BSE. They also have the function of converting BSE signals into standard TV signals in the VHF or UHF bands so that they can be received with conventional TV sets. Their antennae are remarkably small, i.e., 1.6 or 1.0 mø.

LIST OF "BSE" EXPERIMENTS

(1) Experiments on basic technologies in the broadcasting satellite system;

coverage area, transmission system, radio wave propagation characteristics, frequency sharing, characteristics of the satellite, and characteristics of the ground facilities.

(2) Experiments on satellite control technologies and operational control techniques for the satellite broadcasting system;

satellite control techniques, satellite broadcasting system operational techniques, and access of a satellite by multiple transmitting earth stations.

(3) Experiments on reception of radio waves from a broadcasting satellite;

reception of the signal from the broadcasting satellite and the signal quality evaluation, and improvement of techniques for reception of satellite broadcasting signals.

These experiments have been jointly conducted over the past two years by the Ministry of Posts and Telecommunications (MPT) and NHK, and have made satisfactory progress and shown favorable results. (BSE-YURI is the world's first dedicated experimental broadcasting satellite and the results of these experiments have attracted world-wide attention.) As a result of the experiments conducted so far, practical application of broadcasting satellites can be considered technically feasible within the foreseeable future.

YURI has three transmitters, A, B and R. In June, 1979, the Channel-B transmitter broke down, followed by failure of the Channel-R transmitter in May, 1980. On June 17, 1980, the remaining Channel-A transmitter also broke down and transmission from the satellite came to a halt. As a result, projected experiments involving the use of these transmitters have become impossible.

[III] Operational Broadcasting Satellite Program

As described above, it has become clear that practical application of broadcasting satellites has real potential. Thus, in June, 1978, MPT requested that the Space Activities Commission prepare to launch an operational broadcasting satellite in 1983. As a result, the Space Activities Commission in August, 1979, presented the following program:

The aim of the project is to launch operational satellites BS-2a in 1983 and BS-2b in 1985. Both of these will be launched via the N-II type rocket currently being developed in Japan. The BS-2b satellite will act as a reserve satellite for the BS-2a. These operational broadcasting satellites will carry two transponders and will be used to overcome the problem of poor reception of NHK's General Program and Educational Program in remote and urban areas. At the same time, it is expected that this project will contribute to the advancement of technology related to broadcasting satellites.

The total cost of the BS-2a and BS-2b programs is estimated to be approximately 60 billion yen. Of this, it is projected that the government will bear 40% and NHK 60% of the cost. The successful launching of the BS-2 satellites will mean the advent of the broadcasting satellite as a new medium that makes reception possible for every citizen.

[IV] Second Generation Broadcasting Satellites

The BS-2 satellites have only two TV broadcasting transmission channels and these will be employed as a measure to cope with the problem of poor reception of NHK television broadcasts. However, it is certain that in the future technological progress will lead to the advent of satellites that can broadcast a greater number of channels. In connection with such

Second Generation Broadcasting Satellites, successors to the BS-2 and projected for the late 1980's, MPT has begun to study satellite development with the expectation that they will be used by enterprises other than NHK. To this and, the MPT set up within the Research Group for the Use and Development of Radio, a private consultative organ of the Director of the Radio Regulatory Bureau, a new group called the Operational Satellite Sub-Committee. This group will contrive deliberation through 1980-81 to map out what form the second generation broadcasting satellites, BS-3 should take.

[V] Inauguration of the Telecommunications Satellite Corporation of Japan (TSCJ)

In February, 1979, the MPT presented to the 87th session of the Diet a bill that calls for the establishment of the Telecommunications Satellite Corporation (TSCJ). This bill was passed and TSCJ was officially inaugurated in July, 1979. Since it has features both of a commercial enterprise and of a public enterprise, the TSCJ was established as "an authorized corporation" by the MPT under the Special Law whereby the MPT provides all necessary aid and supervision.

TSCJ was set up in order to ensure that communications and broadcasting satellite would be uniformly controlled and operated. The structure and purpose of the TSCJ is summerized below:

[Objectives]

TSCJ aims to promote the growth and development of telecommunications and the effective utilization of radio frequency spectrum in space. This involves effective control of the position and attitude of communications and broadcasting satellites, and granting permission to use the radio equipment on board the satellites to those organizations intending to use such equipment to establish radio stations.

[Capital]

The financing of the TSCJ is jointly contributed by the government and private corporations. Initial capital at the time of inauguration amounted to 840 million yen. The government supplied half of this, 420 million yen, and the remaining sum was contributed jointly by the Nippon Telegraph and Telephone Public Corporation, Japan Broadcasting Corporation (NHK), and Kokusai Denshin Denwa Co. (KDD) in equal shares of 140 million yen. This

capital is gradually increasing and is expected to amount to approximately 7 billion yen by 1983. This capital is earmarked as construction expenses for terrestrial operational facilities to control satellite positioning. However, satellite production and launching expenses are treated separately from the capital fund and are recovered from the organizations using the satellites.

(Business activities)

The main activities of the TSCJ are as follows:

1. Commissioning communications and broadcasting satellite launching to other agencies.
2. Control of communications and broadcasting satellite positions.
3. Licensing organizations intending to set up radio stations to utilize the radio equipment carried on communications and broadcasting satellites.
4. Secondary and related activities:
   Satellites coming under the juridiction of the TSCJ are restricted to communications and broadcasting satellites. This is because other satellites require technical management and operation systems which differ from that of communications and broadcasting satellites, so that management and operation of all satellites under one body is not considered to be efficient.

The establishment of the TSCJ has opened the way to a new era of satellite utilization in Japan's space program. In this regard, the TSCJ can be expected to fulfil the following roles:

1. Realization of operational space communications within the near future.
2. Promotion of planned and efficient use of space communications.
3. Promotion of the growth and development of space communications.

Space development in Japan has now reached a turning point which will lead from the initial phase of groundwork consolidation to a second phase of practical application. In this new stage of development the Telecommunications Satellite Corporation of Japan (TSCJ) is expected to play a pioneering role, opening up new territory in space development in Japan. Communications and broadcasting satellites represent a new medium that holds the potential for realizing many of the dreams that could not be achieved through present

terrestrial systems. The MPT anticipates that new developments will proceed smoothly within the foreseeable future.

[VI] The potential for application of direct broadcasting satellites and the affect on commercial broadcasting

As yet no definite direction has emerged among commercial broadcasters how to deal with the development of direct broadcasting satellites that will be launched after 1985 (the second generation satellites). And this is at present being debated in all of the related fields. For the present it seems likely that NHK will concentrate its energies on overcoming the problem of poor TV reception with the aid of the BS-2 satellites. As a public broadcasting service, it is natural that NHK should pursue this line of action, despite the considerable expense involved, and despite the necessity of also having to continue investment in ground facilities for the time being. However, it is not likely that NHK will confine itself to using the BS simply to supplement terrestrial broadcasting. Nevertheless, NHK is already burdened with financial problems which will stand in the way of future development. The problem of securing revenue to tackle the coming era is one that remains for the future.

With regard to the commercial broadcasting industry, four networks have been established using terrestrial circuits. This system of networks has been operating successfully and the advent of the BS is sure to have a big impact on this system. The Broadcasting Satellite Research Sub-Group under the Broadcasting Legislatory Committee of the National Association of Commercial Broadcasters in Japan (NACB) conducted a survey through 1974-75 on the problems of broadcasting satellites. According to their report, in response to whether broadcasting satellites would be welcomed by commercial broadcasters, the conclusion was unfavorable. The reasons are as follows: (1) It is doubtful whether broadcasting satellites would prove more economical than relay stations as a means of overcoming the problem of poor reception. (2) Transmission of regional programs would be severely hampered and this would lead to disruption of the present commercial broadcasting system which is founded on the principle of regional broadcasting. (3) Satellites can be used as a new mediom to meet the future demand for diversified information, but there is a need to study whether the practical merits of satellites justify the high cost.

(4) Satellites could be used in place of terrestrial circuits, although they were not originally intended for such purposes. However, there would be no economical benefit in using satellites in this way because terrestrial circuits are at present in widespread use.

Following this survey, in September, 1979, the National Association of Commercial Broadcasters in Japan (NACB) reinstated a twelve-member Broadcasting Satellite Research Sub-Group and made a fresh start in actually dealing with the broadcasting satellite situation. Then, in March, 1980, this Sub-Group published an initial report concerning the position commercial broadcasters should take regarding broadcasting satellites. This report was recently submitted to the NACB Board of Directors. However, it has not yet been adopted as the official view of the NACB. The following is an extract from the Research Sub-Group's report:

Depending on how they are used, broadcasting satellites will have an extremely large impact on the established broadcasting system, and will affect future commercial broadcasting management. Therefore, any counter-measures must be decided with the concensus of all commercial broadcasters. For this purpose, the Sub-Group must continue to make a complete and thorough assessment of the situation as regards satellite development in Japan and other countries and also must continue specialized research and investigation into broadcasting satellites, thoroughly probing the issues involved.

Judging from the schedule of Japan's Space Development Program, commercial broadcasters will have to decide their policy on how to deal with broadcasting satellites in two years from now, since the designing and development of the second generation satellite may be started in 1983.

At the present stage, two widely different opinions exist among commercial broadcasters. Those are: (1) That since broadcasting satellites will inevitably become an accomplished fact, commercial broadcasters should also actively participate in the development of those satellites; and (2) That if broadcasting satellites were used for commercial broadcasting, this would pose a grave threat to existing commercial broadcasters, and therefore broadcasting satellites should be utilized for non-commercial purposes.

In view of the present state of progress of the broadcasting satellite program, the Research Sub-Group puts forward the following proposals:

(1) Commercial broadcasters should, at every opportunity, make known their attitude on the following three points:

i) Broadcasting satellite issues are a matter of grave concern to commercial broadcasters.

ii) Thorough investigation into the methods of use of broadcasting satellite TV channels is desirable.

iii) Measures should be taken to prevent any disruption of the existing broadcasting system.

(2) The TSCJ will assume an important role as regards future broadcasting satellites, and in order to make their intentions felt, commercial broadcasters should take a positive approach toward such matters as the participation of the NACB President in the TSCJ Administration Council.

(3) Each broadcasting station should endeavor to enhance the essentially regional nature of its services.

[VII] Proposal submitted by a commercial broadcasting station president:

With the coming of the broadcasting satellite era, the question of how to tackle this new age is one that also concerns commercial broadcasters and is under serious debate. The following opinion was put forward by a certain commercial broadcasting station president who has long been concerned with such issues.

Although commercial broadcasters recognize that broadcasting satellites will be used to surmount the problem of NHK's poor reception and to provide public services such as a university of the air, we oppose the use of broadcasting satellites for commercial broadcasts transmitted throughout Japan. This is because such broadcasts would deal a fatal blow to commercial broadcasters who are at present licensed in conformity with the principle of regional broadcasting. If broadcasting satellites were used for commercial broadcasts this would completely upset the present commercial broadcasting system. Given this situation, there is only one possible course of action. Commercial broadcasters should neither make use of broadcasting satellites, nor allow third parties to make use of them.

In other words, steps should be taken to put the principle of regional broadcasting, by which channel allocation is now determined at the administrative level, onto a legal footing; that is, under the jurisdiction of the Broadcast Law. The law must guarantee that present licensing standards, founded on the localism principle, cannot be readily modified. As long as it is envisaged that broadcasting satellites would be used without contravening the present broadcasting system, we have no objection.

Some people advocate a positive approach: that is, that commercial broadcasters also make positive use of broadcasting satellites, that we should not disregard hardware development, and that unless we adapt to new trends we will fall behind. But how should broadcasting satellites be used, who should use them, and for what purpose and for what kind of programs should they be used? Unless answers to these questions are clarified, the "positive approach" theory remains unclear.

In either case, commercial broadcasters should reach a concensus and convey their opinions to the government in the very near future.

[VIII] An alternative opinion put forward by an executive of a commercial broadcasting company.

The 1980's will witness the opening of the broadcasting satellite age, and Japan is expected to take the lead in the field of operational broadcasting satellites. If such satellites can be utilized effectively, it will be a momentous achievement.

Broadcasting satellites will undoubtedly have a great impact on commercial broadcasters, but the commercial broadcasting industry has not yet taken a unified stand as to how to deal with the advent of such satellites.

It is believed in some quarters that since broadcasting satellites are not expected to become a reality in the near future, there is no need to seriously debate the issues involved. However, this attitude would now seem to be untenable.

Some people also believe that broadcasting satellites pose a threat to the existence of commercial broadcasters. It is feared that, since commercial broadcasters offer their broadcasting services through terrestrial systems to specific regions stipulated under the conditions of the license issued by the government, the sudden appearance of a mammoth broadcasting satellite system would usurp their position.

This is because:

1. The cost of transmitting programs by broadcasting satellites is far cheaper than by ground systems. Thus, if broadcasting satellites were used for commercial broadcasting, ground systems could not compete economically.
2. It is feared that, if present terrestrial television networks were replaced by broadcasting satellites systems, the majority of persons presently employed in broadcasting would lose their jobs.
3. It is likely that advanced technology would mean the replacement of present television technical standards by new systems. The so-called high definition television system, although not regarded as practicable with present ground systems, has proven to be feasible at the experimental stage, and is potentially practicable with broadcasting satellites. Therefore, if commercial broadcasting

were to adopt the high definition television system by using broadcasting satellites, and broadcast programs similar to those of the present ground broadcasting system, ground systems might no longer be a paying proposition.

In order to protect themselves against the threat presented by broadcasting satellites, it has been suggested that commercial broadcasters neither utilize broadcasting satellites, nor permit third parties to use them. As a means of safeguarding the interests of commercial broadcasters, this argument is quite clear. However, it amounts only to a starting point, and represents only the view of commercial broadcasters.

There are probably many people outside the commercial broadcasting industry who would welcome nation-wide commercial broadcasting coverage through a single radio frequency, as well as many within commercial broadcasting management circles who think that space systems could be very attractive if broadcasting satellites were used. It also should be pointed out that this arguement is looking at the question of broadcasting satellites only from the present level of technology.

By around 1990 it may become possible to construct an Orbital Antenna Farm (OAF) on the geostationary orbit by using a space shuttle, and to broadcast with a narrower beam by using a large-scale antenna and high power output. Obviously, concepts of satellite broadcasting will change in the future.

The view that broadcasting satellites pose a threat to commercial broadcasters needs to be further studied. This would involve detailed analysis of the cost of broadcasting satellites, the profits and interests of commercial broadcasters, the work-load of employees, and the progress of satellite technology. At the present time it would seem that the broadcasting satellite launching schedule is taking priority. Greater effort is needed to study both terrestrial and satellite broadcasting systems, and to establish a system that would best suit the needs and meet with the approval of the public.